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COMPUTERS

Philips in National, European Parallel Computer Projects

36980001 Amsterdam ELSEVIERS WEEKBLAD in Dutch 8 Aug 87 pp 16-17

[Report by Bas den Hond: "A Chip is like a Grocery Cart, it Calls on all the Shelves One by One"; first paragraph is ELSEVIERS introduction]

[Excerpts] As fast as the chip developed, one problem is catching up with it: the fact that it faces the job alone in every computer, which limits the processing speed of that apparatus. But the day will come when you can simply add a few chips to a computer that is too slow.

At Philips they believe that that day is only 2 years away.

In a number of laboratories in the world, not least in the Physics Laboratory of Philips in Eindhoven, computer scientists now think they are close to the "parallel computer." Two years from now in Eindhoven a prototype with about 100 chips is to execute its first program in parallel.

Philips is not doing it all by itself, but is involved in a Dutch and European project. Together with the universities of Amsterdam, Twente, Leiden and Utrecht and the Center for Mathematics and Computer Science in Amsterdam they are working on a "Parallel Inference and Storage Machine" (PRISMA), with a government subsidy via the Stimulation Project Team for Computer Research in the Netherlands (SPIN). The European project, which is carried out in cooperation with AEG [German Electric Company] and Nixdorf, gets a subsidy via the ESPRIT program and carries the frightful name "DOOM": Decentralized Object-Oriented Machine. The two projects intertwine in a mutually beneficial manner in the Physics Lab, and "DOOM" has made the greater progress.

At a congress on parallel computers, which Philips held in Eindhoven in June in the framework of the ESPRIT program, the most important characteristics of the new computer were outlined.

A special programming language exists for it, called "Pool": the things which the computer must do simultaneously must be written down in such a way that it knows what is expected. The programming languages used with ordinary computers are not appropriate for that.

Exchange

Through "Pool" and the permanent system software, each of the 100 processors will now be assigned an individual little part of the program which is to be carried out fairly independently. It enters via a special communication chip which functions as a telephone

exchange and hence relieves the chip of the enormous message traffic in this type of computer. The processor has an individual memory for that program and for incoming messages from other processors. A processor immediately starts carrying out its task. It stops when it is finished, or when a piece of information is needed which still has to be figured out by a different part of the program. In that event the message "I'm waiting" goes to the chip which is carrying out that other part.

Naturally the programs must be written in such a way that two processors are not waiting for each other at a certain moment or that a processor is not waiting for a piece of information which will never arrive, so that it will no longer come into action for the remainder of the running time.

Thus with a parallel computer such as "DOOM", the chips are not all working at the same time. The more they do that, the more useful they are. For example, if one wanted to have such a computer do an addition in the elementary school manner, starting on the right and continuing toward the left and with or without "carrying one", it would be utilized in the worst manner. Each chip can indeed take on the addition of one figure, but except for the first chip, they will all have to wait for a report on the outcome of the colleague working one column to the right; the result will be just about as fast as when one chip does all the adding by itself.

Other problems, on the other hand, are crying out for this very same parallel processing. And a number of companies find those problems so important that they are already working on programs for the Philips computer, even though it does not exist yet. Dr Loek Nijman, head of the Computer Science department of the Philips Physics Lab: "AEG is writing a program for computer-aided design, in which considerable three-dimensional information thus must be computed. Shell is also doing something. We ourselves are writing a program which can prove on the basis of the design of a chip that it will carry out its functions correctly, and in the framework of another European project we are doing some work on automatic translation."

"It is not as if we expect our machine to be immediately utilized profitably as soon as it exists. It will be a prototype. If something useful can be done with it, all the better. But it is being made to show that it can be done, and while we are designing it we are keeping in mind the very detailed chip techniques with which we would have to build it in production runs."

"The decision to start its actual manufacturing is not ours here in the laboratory."

"The companies I mentioned apparently see it as an advantage to understand at an early stage how to design parallel programs. It is nice for us that we are somewhat ahead with the building of such a machine. But from a

business point of view it might not be so advantageous to be the first. At Philips we have had that experience before. The introduction is in fact determined by the market."

8700

Esprit's Fault-Tolerant System
36980012 Paris *ELECTRONIQUE ACTUALITES*
in French 18 Sep 87 p 4

[Text] Bull has assumed the primary responsibility for the Esprit program's Delta project. Built around its line of mini SPSs, the project is designed to develop a fault-tolerant system that will operate in a distributed open architecture environment.

The Delta-4 architecture integrates ISO communications standards in accordance with the OSI model. Through new developments, it plans to make a significant contribution to the development of new ISO work on open distributed processing (ODP). The concerned fields of application are, more specifically, factory and office automation, with an emphasis on the real time aspects of data processing.

The Consortium believes it is important to implement the overall architecture in an industrial environment. It is anticipated that the project will be conducted under Esprit 2 and that a large-scale pilot site will be installed at the BASF factory in Ludwigshafen, Germany.

12798

FACTORY AUTOMATION, ROBOTICS

Duerr of FRG Tests Robot With New Image Processing System
36980006 Coburg *MASCHINE UND WERKZEUG*
in German 3 Jun 87 pp 30-31

[Article: "Robot Recognizes Workpiece Position: Cylinder Block Removal Using P 100 Industrial Robot with Visual Recognition System"]

[Text] The first seeing robots are already in operation. Using a camera-equipped workpiece-recognition system, they find workpieces, remove them from a parts cage, and place them on a roller conveyor, which transfers the castings to the machining line.

The first seeing robots have been installed in the automobile industry, where they are making a very decisive contribution to humanizing workstations: The V6 gray iron cylinder blocks, weighing approximately 40 kg, are removed individually from the so-called rack (a kind of parts cage) by robots working in an 18 second cycle and set down on the a roller conveyor. For these handling tasks, Duerr's P 100 gantry robot system was equipped with an image recognition and processing system, whereby the camera communicates with the end effector.

Even Recognizes Tilted Parts

Two layers of parts with twelve cylinder blocks each are stacked in each rack without any divider between the layers. First the end effector with the camera moves to the position where the first casting is located; the camera only picks up this limited section of an image from the rack, and the image recognition system processes the picture. It resolves the picture it has taken into 256 x 256 pixels. Each pixel is assigned one of 128 gray values. The image with the six cylinder bores is preprogrammed in the recognition system, which involves one difficulty: Because of the V-arrangement of the cylinder bores, the bore axes lie at an angle and appear in the image as ellipses, which change as the crooked position of the part increases. The blocks are reliably recognized and picked up in an oblique position of up to 5° or 6°.

An additional program is derived from differences in brightness, influenced on the one hand by the lighting, but also on the other by the casting surface, for instance by surface rust. In this case, the advantages of gray value processing come fully to the fore. The system can adapt to certain environmental limits.

Within about 300 ms, the image recognition system recognizes the cylinder bores and other distinct points for determining part orientation. Then the X- and Y-values, as well as the tipping angle, are passed on as information to the robot control system so that the robot end effector can move over the cylinder block.

Height Scan

The Z-axis (vertical stroke) is controlled tactilely by a spring-loaded system. First the end effector moves quickly to the cylinder block, slowing down as it covers the last 100 mm to the workpiece. While the end effector sets down, it first backs off, then releases a limit switch. This system has proven itself in practice. It is reliable in operation, and until now it has the advantage of greater operating reliability than non-contact systems.

If the cylinder block is lying at an angle, the flexible end effector adjusts to its position. The pick-up fingers pull the block to a defined position with respect to the pick-up plate. As the Z-axis is lifted, the pick-up plate centers itself, making it possible to place the block down on the roller conveyor, which carries it away.

In general, these handling tasks involving individual non-machined castings are not very demanding in terms of accuracy. Positioning within 2 to 3 mm is adequate.

Ultrasound Sensor Check

Since the recognition system is only designed to recognize the hole pattern, additional safety measures are necessary to ensure that the end effector will not self-destruct if the recognition system has not recognized a block, for instance because it is lying at too great an

angle. Therefore, after a layer of workpieces has apparently been removed, there is an additional ultrasound check to determine whether a cylinder block or other part may possibly have been left lying in that layer. Only after this check does the end effector go on to remove the bottom layer.

The recognition system described here has been operating since the end of last year in an automobile factory, providing satisfactory performance. Even though this application still represents a pilot project, it still represents an essential step in the direction of seeing robots.

13127

MICROELECTRONICS

France's VHSIC Program To Achieve 1.25-Micron Technology

36980003 Paris *ELECTRONIQUE INDUSTRIELLE*
in French 1 Sep 87 pp 63-66

[Article by Gilbert Rhemes: "The VHSICs, From Military Circuits to Civilian Spinoffs"]

[Excerpts] The VHSIC program (Very-High-Speed Integrated Circuits) of the Pentagon was launched in 1980; it was designed to provide a technology for missile guidance, weapon systems and electronic warfare. It is a three-phase program involving nine contractors during Phase 0, which lasted 6 months; six contractors during Phase 1 (Honeywell, Hughes, IBM, Texas Instruments, TRW and Westinghouse), from 1981 to 1984; and three (Honeywell, IBM, TRW) during Phase 2, the current phase, to be completed in 1989.

The French VHSIC Program

In 1983, when the French VHSIC program was launched, it was out of the question that circuits under development in the United States should be offered outside the United States. Yet, the French VHSIC program still benefited from the initial phase of the U.S. program, as some elements of the latter seeped into the public domain.

The objective of the French program was therefore clearly defined: to make circuits similar to those made in Phase 1 of the U.S. program, i.e. to achieve 1.25-micron technology 2-3 years after U.S. circuits. The objective being defined, the material content of the VHSIC program as well as its length were perfectly determined: the last commitments will be made during 1988.

The orientation of the studies is clear-cut: signal processing circuits must be manufactured better today than yesterday, and better tomorrow than yesterday. "Today" means the 2-micron technology which French contractors have already achieved. This leading-edge electronics—thus called because it will be used on torpedoes, sonars and on-board radars—is characterized by a small

volume, low electric power, a high input rate (a few million bits per second) and a very high computing rate (measured in gigaflops). Very-large-scale integration is a must, but it can use existing resources: CAD and commercial testing tools.

The goal of the French VHSIC program was to integrate 10,000-30,000 gates per circuit. Design times are relatively high: 15 man/year (including 10 for the layout) for a 16-bit microprocessor with 3,000- 5,000 gates. In addition, because they are military systems, VHSICs are produced in small quantities (all the smaller as the degree of integration is higher), something to which IC manufacturers are not used, as they favor mass production to make their investments pay.

The cost of the studies is therefore high and will not be amortized over a great many circuits: not every user will be able to afford these circuits. But component manufacturers are not about to launch into production at a loss; equipment manufacturers have been warned, there is no market price.

The objective of the VHSIC program is to give to the French industry the means to design and produce signal-processing machines using the most modern technologies for highly-integrated digital circuits. Because systems are the main concern, the prime contractors are equipment manufacturers. Indeed, systems must receive the benefits of technological developments as soon as possible, and the specific needs of the military (working environment, self-testing capability, etc.) must be considered.

The contractors of the VHSIC program started by trying to provide equipment designers with libraries of basic function cells together with their assembly rules; they also implemented CAD resources (analysis, design, simulation) adequate to meet the VHSIC program requirements for all levels of architecture.

The Contractors

The VHSIC program hinges around three groups of manufacturers: the GETS (Signal-Processing Study Group) and the CCRC (CMOS Components for Radio Communications) rely on CMOS technology; the GTTS (Signal-Processing Working Group) relies on bipolar technology.

The GETS consists of ESD (Serge-Dassault Electronics), CETIA (European Company for Aided Engineering Techniques), a subsidiary of Thomson/CSEE [Signals and Electric Projects Company], and TRT [Radio and Telephone Telecommunications] for the studies, plus Thomson Semiconductors for the silicon foundry, with MSH [Matra-Harris Semiconductors] as an alternate source. The CCRC includes TRT and Thomson-DTC. Finally, the leader of the GTTS is no other than Thomson-CSF (Detection, Control and Communication Systems branch).

The CELAR [Armament Electronics Center] is responsible for the characterization of the products manufactured. State financing currently amounts to Fr330 million. Manufacturers will spend at least as much for their developments.

ESD: MICA Homing Heads

ESD is prime contractor for the GETS, a group which includes CSEE and its subsidiary CETIA as well as TRT. Their goals are signal processing to steer the MICA (Interception and Air Combat Missile) by means of a homing head (seeker head) by 1993; proximity fuses, small radars, jammers, GS Navstar and other applications.

"The program was launched 2-1/2 years ago," we were told by Jacques Mijonnet, head of the Homing Head Division at ESD. "Two successive phases were defined: that of 2-micron technology circuits has already been completed in 1987; industrial availability of Phase-2 1.25-micron circuits is expected to be achieved by 1989."

"The originality of the VHSIC program lies in the approach used, which initially consisted in analyzing foreseeable signal processing needs, and then attempting to reduce these to recurring operators. Therefore, it amounts to setting up a library of operators by assembling cells and macrocells" (Table 1). This approach differs from that of application-specific IC (ASIC) manufacturers who, a priori, do not know the end use of their basic component libraries, whereas the VHSIC program defines this library for predetermined functions.

Table 1 - GETS Circuit Specifications

	2-Micron Technology	1.25-Micron Technology
Operating frequency	10-25 MHz	20-50 MHz
Propagation time per gate	2-5 ns	1-2 ns
Number of gates (one gate is the equivalent of four transistors)	150,000	20,000-60,000
Surface area of one circuit	80 mm ²	80 mm ²
Consumption per circuit	1-3 W	1-3 W
Number of pins	125-150	125-150

Setting up the library involves two stages: first, designing its components as a whole, and characterizing them by means of test circuits and a pilot circuit. Nowadays, everything is developed in 2-micron technology," Mr Mijonnet added, "and we are starting to redo the job

in 1.25-micron. Testability is of course one of our concerns: we are writing testing software that will provide a failure coverage rate of 95 percent."

GETS Achievements

In a first stage, the GETS designed microcells, i.e. elementary gates which were defined in cooperation with the silicon founder.

It then went on to general skeletal cells for series processing (serializer register, offset register, multiplexer, interface cells), to parallel processing (adder, arithmetic and logic unit, counters, comparators) and to memories (RAMs, ROMs, PLAs, registers, stacks, etc.).

The next step covered architecture-specific cells. Finally, all macrocells (multiplier-accumulator, divider, square-root operator) were developed. They are produced progressively with the Mostek technology of Thomson-CSF.

Equipment manufacturers, therefore, can already find cells and macrocells to achieve the functions they need today.

CCRC: The Fourth-Generation Radio Set

Thomson/DTC (Telecommunications Division) is a participant in the CCRC, with TRT. "Radio communications have experienced considerable technical developments in the past 10 years or so," Daniel Brisset, technical director, explained. "This is due to new constraints linked to electronic warfare resistance: indeed, the transmission channel must resist detection, location and jamming." This mutation, which evidently requires increasingly complex equipment, has been accompanied by an explosion of signal processing requirements.

"On the other hand, some equipment is tactical, which results in consumption constraints: a portable set powered by a 4-Ah Ni-Cd battery must be able to operate for 20-24 hours and must not weigh more than previous-generation equipment."

In short, there is an increasing need for CMOS-technology VHSIC circuits because of their low power consumption. "Our projects cover portable applications in the HF (decimeter waves) and VHF (30-88 MHz) range; equipment likely to be taken on board an aircraft, in the UHF (225-400 MHz) range; and, for the new ground-to-air links, in the 960- 1215 MHz range. This is the Simtac program, which involves time- division multiplexing among many users."

Among the protection techniques implemented, we should mention the frequency jump (very fast change in the transmission frequency, lasting from a few microseconds to a few milliseconds) and the spectrum spread, which consists in modulating useful data through a very fast pseudo- random binary sequence.

"In the middle term, in 5-7 years, there will be a demand for complex VHSICs with 50,000 gates," D. Brisset added, "hence the risk of increasing costs and development times." This alone warrants the CCRC program (CMOS Components for Radio Communications) whose objective it is to define a library of telecommunications-oriented cells and macrocells in 1.25-micron technology, in part with a 2-micron stage (for the cells).

"We have a 30-cell program; the first 20, developed in 2-micron technology, are operational. Their conversion to 1.25-micron technology (now in progress) will be completed by the end of 1987. Ten more cells developed directly in 1.25-micron technology will become available early next year. They will be followed in 1988 by some 15 macrocells developed directly in 1.25-micron technology."

"Other Thomson-CSF units are also involved in the VHSIC program: Cimsa- Sintra for computers, AVG (general avionics) for displays, LMT for friend-or-foe identification on the battlefield. We were thus prompted to expand the program."

In 1.25 micron technology, the operating frequency will be in the 25-30 MHz range, with a propagation time per gate of a few nanoseconds; the circuits will consist of 20,000-50,000 gates on less than 200 mm² and will consume less than 500 mW. Here, as at ESD, work on circuit architecture has followed the definition of equipment manufacturers' requirements. Requirements have determined the nature of the cells. Similarly, overall efforts have been made on CAD tools, testability, portability (possibility of a second source).

"Two-micron technology cells were designed with traditional CAD," D. Brisset recounts, "the number of levels of any register is set, cannot be changed. We are now considering using a CAD chain to implement the whole 1.25-micron phase. This would enable us to develop skeletal cells, what we call cell generators." For this, they will adopt a silicon compiler for the CCRC program as a whole, and improve it on the basis of internal studies, such as the Sycamore study of Thomson Semiconductors.

The macrocell library includes a 16x16 multiplier, a data path, a sequencer, a correlator, etc.

It will find an application in the fourth-generation radio set designed for the battlefield and capable of withstanding electronic warfare aggressions. The set will contain five VHSIC circuits from the French VHSIC program. For its part, TRT is tackling the modem application, for HF-range transmission.

According to D. Brisset, when the CCRC has completed its task, the cells and the program will have to be maintained; for instance, around 1990-1992, the transition to HCMOS-4 and submicron (0.8 micron) technology should be considered.

GTTS: Bipolar VHSICs

The SDC Division (Defense and Control Systems) of Thomson-CSF, for its part, is committed to bipolar technology: the GTTS (Signal-Processing Working Group) started its program on 2 January 1982.

Today, the GTTS consists of 50 systems engineers expert in VHSIC design, working in Meudon and Montrouge. It also includes 50 components engineers and technicians working in Saint-Egreve to develop and industrialize the technology, a coherent CAD chain, "the best in Europe," the project head, Claude Legendre, commented, a proven working method: "The circuit works right from the first test." STL (Schottky Transistor Logic) 2-micron technology ICs are now being produced with 10,000 gates, one gate consisting in this case of 1 transistor, 5-6 diodes and 3 resistors. "STL technology offers the best speed/consumption ratio." GTTS also means an operational 1.25-micron technology and a Class-20 white room in Saint-Egreve.

In 1.25-micron technology (Table 2), an STL gate has a typical propagation time of 0.5 ns and will dissipate 100 microwatts. In the worst possible case, these values become 1 ns and 150 microwatts: a 20,000-gate circuit will thus not use much more than 3 W; "it is therefore no worse than an MOS circuit!"

GTTS 1.25-Micron Technology

	1981 Estimates	1986 Estimates
Practical integration density	350 gates/mm ²	290 gates/mm ²
Power/operator	150 microwatt	100 microwatt
Speed/operator	1 ns	1 ns
Complexity	10,000 gates	20,000-25,000 gates
Number of circuits to be designed	5	1

Two circuit families have been developed and characterized. The first one offers FFT (Fast Fourier Transform) functions with seven different circuits: 24-bit floating point multipliers (9,000 gates over 1 cm²; cycle time 25 ns), 24-bit floating point adder (7,000 gates, 25 ns), "toggle" type RAM (2x1.5 Kbit cache: one half of the memory is used while the other is being charged), bus multiplexer (9,000 gates), address processor (6,600 gates), control and sequencing of the FFT algorithm (6,340 gates), input-output management, operator self-test (4,400 gates).

"It takes 100 ns to compute a butterfly," C. Legendre indicated, "and 5.12 ms to compute a full FFT over 1,024 points. In addition, the system is programmable and can be used for weighting and correlating. Its precision can be said to be in the 8,000-32,000 point range."

The second family is that of the "Moustic" processor; it has an SIMD (Single Instruction, Multiple Data) architecture in which all elementary processors are carrying out the same task on different data. This circuit is designed to manage very fast data flows, e.g. in a radar (one complex data every 200 ns). Moustic integrates 4 different circuits: the 24-bit floating point multiplier (cycle time: 50 ns; 5,600 gates on 1 cm²), the arithmetic and logic unit (9,800 gates), the address processor (6,600 gates) and a resource management circuit (9,630 gates). The complete machine consists of 112 GTTS circuits and provides a processing power of 320 Mflops!.

"In Phase 2S (simplified) of the program, for which we used a reduced set of macrocells, we are integrating 290 gates per mm² in 1.25-micron technology. We shall reach 300 and 390 gates/mm² with a silicon compiler. Consumption is 100 microwatt/gate and we are able to go

down to 50 microwatt/gate." All circuits have an integrated test area, and an observability area so that they can be tested with current machines, such as the GR16 tester of GenRad (with 144 pins).

All participants in the French VHSIC program agree that it is 2-3 years behind the U.S. program, but not much more! Their initial objective has therefore been reached.

"We are now capable of designing VHSICs with 20,000 gates, which will work the first time around," C. Legendre added, "this gives us a very honorable rank in the international community. An additional study aimed at a complexity level of 50,000 gates per chip has been started."

9294

BIOTECHNOLOGY

Training in Biotechnology Said Sporadic, Inconsistent

25020006 Budapest HETI VILAGGAZDASAG in Hungarian No 37, 12 Sep 87 pp 55-56

[Excerpt] The domestic universities of natural and technical sciences have started to incorporate biotechnological knowledge into their curricula more-or-less simultaneously. At the Technical University of Budapest, the teaching of biotechnology was started in 1985, based on the bio-engineering training already in existence. Within this framework, biology is offered mainly by the faculty of Eotvos Lorand University (ELTE) but about two-thirds of the material consists of technical knowledge. The same thing is found in reverse—with a two-thirds predominance of biology—at the ELTE faculty of science where, in 1984, a departmental group was established for teaching biotechnology. Fourth year students in biology can apply for this specialized training who will take four hours a week of biotechnology for two semesters and will have a total of 240 hours practical training in their last year of study. The course of study, which was compiled with great circumspection, was completed by seven students in 1986 with ten students expected to complete their studies here this year.

Although there is no separate subject under such name, the biology students of Jozsef Attila University (JATE) in Szeged have been given up-to-date biotechnological material for 8 to 10 years based on the renowned school of microbiology there. By now, similar type of instruction is also provided at Kossuth Lajos University of Debrecen. As of March this year, instruction in food industrial biotechnology was begun for fifth year students at the Horticultural and Food Industrial University of Budapest.

A biotechnology group was set up also at the University of Agrarian Sciences in Godollo (GATE), whose head came from the Szeged Biology Center of the Hungarian Academy of Sciences. This group teaches preponderantly microbiological biotechnology. At the Department of Plant Culture and Animal Husbandry of GATE, a biotechnological program corresponding to their own field of specialty was set up. At the University of Veterinary Medicine, reproductive biological technology has become an elective subject since September of last year although the students can also encounter such knowledge incorporated in other subjects. Otherwise, it is the medical universities that have been lagging most in the systematic teaching of biotechnological methodology although, depending on the economic possibilities, it is expected that procedures requiring biotechnology will become more and more widespread in the pharmaceutical industry.

The number of students receiving instruction in modern biotechnology in the course of their regular university studies in Hungary and the depth of such training are not

known because of the lack of truly meaningful data. At any rate, it is of concern that completely different material is presented under the title of biotechnology from one university to another. Every alma mater teaches what it considers best and thus the value of the degrees also differs; as stated by a leading domestic scientist who has long been engaged in biotechnology: often not even the university lecturers on the subject are prepared to teach the modern concepts. Appropriate equipment is also lacking; thus, advanced training today could only be provided by a research institute well equipped with such tools. Therefore, the current system of JATE appears to be the most expedient because the students can gain practical knowledge through advanced international courses set up in the Biological Center of Szeged (SZBK).

However, no matter how the universities are striving, they will probably not provide biotechnologists ready for work for a long time—this holds true not only in Hungary but practically everywhere. Therefore, the world over, including Hungary, an attempt is made to base the supply of trained specialists on postgraduate education. A two-year course of training engineers specialized in biotechnology was started at the Technical University in 1984 and in Godollo in 1986. The former is open only to engineers and university-graduate chemists while the latter is also open to biologists engaged in research and education. In the first year, there were 36 applicants in Budapest 26 of whom completed the course. Based on the examination results, the highest level was achieved by chemists who graduated from traditional universities and have more complex knowledge and the lowest level was achieved by the engineers from Veszprem whose training was based mostly on inorganic chemistry—as revealed by the Protein- and Biotechnology Bureau of the National Institute of Technological Development (OMFB). According to the rules, the course cannot be started with fewer than 20 participants; nevertheless, the second course at the technical university was actually started with merely 18 students. This year, there were 29 applicants in Godollo but here too the number diminished by about 10 by now.

These numbers seem extremely low compared to the number of biotechnologists whom the domestic enterprises could already employ today and, therefore, the OMFB is searching for additional solutions. Last year, the Institute of Postgraduate Studies of the Technical University of Budapest announced a lecture series on biotechnology; it is true, there were so few applicants that the course was cancelled at the time. This year's course, which provides no certification and no compulsory examination, was received with greater interest: beginning in September, some thirty-one individuals will start attending the lectures.

However, these courses for engineering specialists serve merely to brush up on knowledge, they provide little practical knowledge. In addition, perhaps for lack of experience, some industrial and agricultural enterprises

send people to the course who have no concept of the necessary biological and chemical foundation. This in effect is a fraud against biotechnology—remarked a lecturer who also had similar experiences, because in such an instance biotechnology is at most a cover for obtaining money: state support can be hoped for under such premises.

The individual training of research scientists, organized by the Biotechnological Bureau of OMFB, can be considered perhaps the most successful form of postgraduate training. In this framework, enterprises and institutions which want to retrain their specialists into true biotechnologists can send them to various renowned biotechnological research establishments for a year each. To cover the added expenses of the host, OMFB provides 200,000 forints per individual and, furthermore, contributes imported chemicals in the value of \$1500 to the training program. The original salary and housing expenses of the trainee are paid by the employer who sent him. So far 58 people took advantage of this form of training which was started in the summer of 1984; there are currently 24 trainees.

The lucky ones who had been accepted to the Agricultural Biotechnological Center of Godollo currently under formation, will also spend two years in other laboratories in order to prepare for their later tasks.

Learning the methods is thus the main goal of those selected. But they do not quite know yet what they will do when the center is opened, what their precise tasks will be. For example, Maria Baranyai, who applied in response to an announcement of the competition right here in HVG [HETI VILAGGAZDASAG] and left Phylaxia, her earlier place of work, is of the opinion that perhaps even the administrators of the new institution do not see clearly what they will do with her at the large research establishment yet to be completed in the future.

This disturbing bewilderment accompanied the young biologist throughout her two years in Szeged. She had to take a course and examination at the university in a subject she already passed before; on the other hand, she could not attend the international course of the Biological Center in Szeged, which would have been useful to her, because of a conflict with one of the required university lectures which was largely superfluous at the end.

Additionally, the current salary of the young scientist, engaged in tissue culture research, is far below that at her earlier workplace. Her perseverance she explained by her faith in the future of biotechnology. However, one cannot very well live on faith in the long run. Most recently, 13 research positions were announced by the Biological Center of Szeged but only 3 to 4 people applied; they were able to offer them salaries that were lower than those paid to a cleaning woman there...

2473

COMPUTERS

Head of 5G Software Firm Interviewed
25020001e
COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 16, 12 Aug 87 p 9

[Interview With Csaba Faykod, vice-president of the 5G small cooperative, by Janos Andor Vertes: "I Don't Like Associations!"]

[Text] If we leave the first five letters out of the name DATORG a G remains. He who knows where the seed ripened for 10-15 years from which at the beginning of the 1980's sprouted the pjt [civil law association] which later grew into the 5G Computer Technology Service Small Cooperative could actually derive the designation from this. This is perhaps a more precise etymology than the fifth generation, which no one would have thought of from the old emblem depicting the 5 intertwined with the G or from the newer square grate logo where the 5 casts a G shaped shadow. But who seeks the meaning today? The 5G is the 5G—a number and a letter. It can be pronounced, it stands out from the others, and what a professional or an outsider thinks of on hearing it depends on whether the clever name giver succeeds with its products and activity in winning a real name for itself.

And it has. If I say 5G to someone today he does not think of fifth generation but rather of the Rair supermicro. And some could add: Rair Limited in Hungary. (It is one of the few mixed enterprises where the Hungarian founder took a private undertaking and made a small cooperative into a legal entity.) And if we continue the association exercise we will hear about the possibility of foreign employment, about intellectual export. To the West. "5G?" a more or less insider acquaintance asks back. "Are they the ones who didn't join PerComp or Szimbiozis, who will join with no one?"

Is this what 5G means? This string of associations could be the question for vice-president Csaba Faykod. Let us begin at the end.

[Question] Why this aristocratic reserve, why doesn't 5G build partner contacts?

[Answer] I don't like associations. When the small undertakings appeared along side the traditional computer manufacturers and vendors the market became lively and the world became more colorful and beautiful. The associations don't really mean a division of labor but rather price cartels; the picture becomes gray again; instead of variety one gets the same thing from every member of the association, and at the same price. I'm not really mad at anyone; personally and professionally we have very good contacts with, let us say, Instrument Technology or Microsystem, but in my opinion business is business when we represent competition for one another, not when we form associations. If we want to form a gt [business association] then we have the Foreign

Trade Bank or MUART [Technical Goods Marketing Enterprise] where the gt has a different structure and task than if small cooperatives with the same sphere of activity were to form an association. Of course I don't want to offend anyone by saying this, it is simply that when it turned out at the time of the announcement of the OMFB [National Technical Development Committee] contest last fall that only associations could sign up for PPC [professional personal computer] manufacture we just didn't sign up.

[Question] But 5G does deal in selling PPC's. As matters stand now it appears that the "losers" are no worse off than the "winners."

[Answer] Is that a question or a statement? We do sell PPC's, not only the XT or AT categories but now a 386 as well. But in the hardware area we have specialized on real multi-user systems and supermicros. I do not believe that a multi-user machine can be made out of an IBM PC, a network card and software. It is possible that this theme belongs to the previous question too; there are still too few small undertakings to cover the market, and when demand is greater than supply there is a possibility for some swindling.

[Question] Would the Hungarian firms offering networks be swindlers? Then Novell is a swindle too, no?

[Answer] Novell does not recommend that someone choose a network made out of IBM PC's in place of multi-user systems based on VAX, Siemens or Rair but rather that if someone has IBM PC's they can be tied into a network so that the system will be expanded with new, favorable properties. These favorable properties resemble what, let us say, a Rair multi-user supermicro offers, but they are not the same. In essence what is involved is like when a bear and an eagle meet on a peak above the clouds, and the puffing, panting bear looks with wonder at the easy, dignified fluttering of the eagle, who explains things as follows: "Look, of course you are worn out, because you had to climb up here. I descended...."

[Question] And does it not happen that, let us say, some "swindler" talks a customer into a supermicro when a PPC would solve his task?

[Answer] If you are asking whether here, where—if there were no market problems—everyone can allow himself a bit of swindling, then how much does the 5G permit itself, then I would say that we are somewhere in the middle. Should I promise you now that after tomorrow it will not be so? It bothers me much more if we do not do something in a professional way. For example, I was dissatisfied with our BNV [Budapest International Fair] stand. I would have liked it if our announcements had succeeded better. And certainly there are some amateur traits in a few of our products or business deals, and it would be good to eliminate them.

[Question] It would also be good if we might illustrate with a few examples what Csaba Faykod means by amateur business and by professional business.

[Answer] The news is already out that Borland is preparing Tulip, to compete with Lotus 1-2-3. Well, secrets should be kept but I do not feel that a contract broken by partners puts an obligation on me, so let me say that Borland is not developing Tulip, Andromeda is. There may be no need to describe the founder of the firm, Mr Stein, of Hungarian origin, in greater detail, it being well known that Novotrade represents his developmental capacity. And the chain is not yet at an end, because Novotrade did the development with the aid of 5G. If we want to be quite concrete with the aid of three former 5G software people who went over to Novotrade in the concluding phase of the work. We do not yet know how the disputed questions between Borland and 5G will be resolved, but we feel that in this business we somehow were not truly professional.... Let us look at a contrary example. The development of our other Western contacts betrayed perhaps fewer amateur traits. The first customer for our architectural CAD program, the APEG GmbH, found that we could be long term partners of each other. We got them to agree that extra profit should not be made by exploiting a momentary embargo policy, that certain and lasting profit is promised only if there is always a software manufacturing capacity which can appear on the market in large volume at any time. APEG brought us together with the Rair GmbH and the three of us formed the limited liability company with 26 million forints base capital. At present more than two dozen of our people work in the FRG, Austria and Switzerland. Our intellectual export last year reached one million marks, and this year we signed a frame contract in Switzerland for one and a half million francs. Our finished programs can also be sold well on the Western market; the Fahrschule program which was successful in the FRG is now being reworked into the French language (and for the French traffic regulations), there are 40,000 driving schools there too.... We want to increase the base capital of the company to 120 million by bringing in a bank and three other firms and we would like to manufacture and export computer technology products to a value of 3-3.5 million dollars annually.

[Question] What products?

[Answer] I told you that we are striving for professionalism! I will not be such an amateur as to divulge our plans.

8984

Chance for Hungary Seen in Area of Graphics Terminals Only

25020007 Budapest

COMPUTERWORLD/SZAMITASTECHNIKA in
Hungarian No 17, 26 Aug 87 p 9

[Interview with Pal Verbely, chief of the electronics main department, MTA SZTAKI (Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences), by Attila Kovacs: "Computer Graphics There and Here"]

[Excerpts] Pal Verbely (40) is an electrical engineer and

a candidate. He is chief of the electronics main department of MTA SZTAKI and one of the youngest members of the "great generation" of Hungarian computer specialists. He participated in the GD-71 and GD-80 projects of the research institute and under his guidance were realized the professional graphics devices of the GD-85 family. During his studies in the United States he designed the floating point arithmetic unit for the Brown University graphics system (BUGS). When we asked him what he was proudest of he modestly mentioned the radar simulation training system which he and his colleagues created from network to computer, from user software to applications. To the question what his greatest professional problem was he answered: "The frequently missing links in the domestic innovation chain cause the most trouble."

[Question] What will the graphics system of the near future be able to do?

[Answer] ...Three-dimensional color raster display hardware will be increasingly useable. As a result of development there will be realtime handling of three-dimensional images. The picture screen of the future will not only be a cathode ray tube. There are already plasma panel displays with 600 x 800 pixel resolution and color versions of these can be expected in the near future.

[Question] To what extent will we Hungarians be able to follow this unheard of development?

[Answer] I think it will be increasingly difficult, because the devices for modern graphics are increasingly expensive compared to our finances. But there is an area, graphics terminals, where we are able to follow development. In my opinion there is a great need for Tektronix type terminals, the most useful and most economical domestic realization of which are built on the IBM PC architecture. XT or AT type configurations, expanded with a high resolution graphics card and monitor, can be used as medium performance, independent work stations. Large numbers of CAD applications for such devices have been and are being made throughout the world. But the resolution of the IBM EGA card is no longer sufficient in such demanding terminal applications; they will require 1024 x 768, 1024 x 1024, 1280 x 1024 pixels.

We can also expand the PC's with a complete graphics subsystem, thus achieving realtime image handling.

With the aid of the expansions mentioned one can create internationally accepted, workstation category devices with conversational capability. Using the foreign hardware and software experiences such graphics workstations can be produced under our domestic conditions with less effort and substantially more quickly than if we began from basics and started a new development to make them.

In addition to increasing the graphics capabilities expansion with a 32 bit auxiliary processor and a UNIX operating system is an important area, especially in demanding CAD applications (for example in three-dimensional mechanical and architectural, IC design and simulation systems). When setting the task it is important to remember the fact that the work stations to be developed in this way can strive not only for expansion of the XT and AT inventory already existing in the country or to be obtained in the near future because the 386 PC's can also be expected to appear here soon.

The idea of integrating the independent PC based workstations into group work sites in a domestic megamini computer environment, in Ethernet compatible networks, coincides with the plans of Hungarian manufacturers.

8984

Hungarian-FRG CAD/CAM Sales Firm
25020001f Budapest
COMPUTERWORLD/SZAMITASTECHNIKA in
Hungarian No 16, 12 Aug 87 p 30

[Text] Beginning in September, according to the plans, a new West German-Hungarian mixed enterprise will begin operation in Budapest—the MTT Kft [MTT Limited Liability Company]. The first two of the three letters stand for the Muszertechnika Kiszovetkezet [Instrument Technology Small Cooperative], the third letter refers to the Tebimpex GmbH; they are providing 48 percent each of the base capital and Technova and Artex will be their partners to a minor extent.

The MTT came into being as the resultant of various aspirations. One was that the Instrument Technology Small Cooperative had already gained some experience in the area of vending CAD/CAM systems, but the constantly increasing domestic needs gradually exceeded the acquisition possibilities. Another aspiration was that of the chief authority. For a long time the Ministry of Industry has been seeking possibilities for technology flow and domestic coordination of computerized design and manufacture. And finally the foreign aspiration—Tebimpex, a significant Western European vendor of CAD systems, indicated to the Ministry of Industry its inclination to found a mixed enterprise for this purpose in Hungary.

Earlier Tebimpex represented CADdy, but in accordance with an agreement made with Instrument Technology they obtained this year the right to represent PC-Draft and so the MTT Kft can begin its operation with the best CAD system according to the comparison published with our article. The MTT Kft sales receipts plan for the first 12 months is for 100 million forints and during this time they would like to double the base capital of half a million West German marks.

8984

BECKERbase, Tulip Software

25020001d Budapest
*COMPUTERWORLD/SZAMITASTECHNIKA in
Hungarian No 16, 12 Aug 87 p 8*

[Article by Janos Andor Vertes: "We Are In The Swim"]

[Excerpt] It is summer, it is warm. With whom does the computer technology journalist meet in the cool water of the Balaton? Naturally he meets with his profession. Beside the pier one of his editorial colleagues is playing ball with his boys. It is not difficult to recognize in the bearded surfer the chief bookkeeper of one of the small cooperatives, although he would be cleverer riding the waves of the regulators. And here the designer of BECKERbase is splashing in the water. We are taking our ease.

"Can I do a portrait of you?" I ask the software designer.

"Don't be silly," he answers, and continues a bit more officially: "You don't have to advertise that BECKERbase is Hungarian software."

Well, if I don't, I don't. Anyway, we are on vacation. We can read the newspaper too. But the announcement in the daily takes us into dangerous waters. The colleague is furious that BECKERbase appears in MAGYER NEMZET at three times the price announced at the press conference, and I am hurt that the vendor is making the whole thing look like the Hungarianization of West German software. OK, I know that Data Becker bought the rights. But it is not necessary to deny the author because of that.

"And what goes with the Borland spreadsheet, Tulip, which I am informed you all are preparing?" I look up from the paper to the software developer.

"You know about that too?"

"Look, you live from software, I live from information. I will write it if it is true. Is it true?"

"I am not authorized to confirm or deny a trade secret...."

8984

Hungarian Efforts To Control Software Black Market for BECKERbase PC

25020001c Budapest
*COMPUTERWORLD/SZAMITASTECHNIKA in
Hungarian No 16, 12 Aug 87 p 5*

[Article by Szilard Szabo: "With Market Tools Against the Black Market; The BECKERbase Pretext"]

[Text] It is not a Hungarian speciality. In every part of the world the manufacturers and vendors of software are in "antagonistic" opposition to the program pirates and illegal distributors. The situation is simpler and less

dangerous if someone tries with intellectual feats to break the protect system of programs in order to expand his collection. It is much more serious when illegal distributors profit from products created by many man-years of work.

We might dismiss the question by saying, "Such is life." According to the memorable saying of G. B. Shaw, mothers who fear for their daughters and inventive suitors are in the same eternal contest as those who develop armor and those who manufacture cannons. If the great Irish dramatist were alive today he might mention the fierce struggle of software developers and software thieves as an example....

Others feel that we must fight with legal means to create purer market conditions. Of course this is true theoretically, but in reality software trials are very rare.

So will the present situation persist, where one can obtain virtually all significant software at a price of five or six figures? With unclear vending rights, with Xeroxed documentation (in the good case) and without guarantee or support?

We might also say that the user should blame himself, for he knows that he is mixed up in a shoddy deal. In reality the buyer is entirely at the mercy of others, for there is no possibility of choosing among vendors—Eat it or leave it, you'll get nothing else! Realistically there are only two choices: Either develop (or have developed) unreliable, custom software, slowly and at great expense, or buy what got into the country one way or another.

What Can Be Done?

This unblessed situation is causing a lot of damage to the people's economy. Gabor Renyi, director of the Novotrade company, said at a press conference that the Western partners are often distrustful of the Hungarian market, saying that Hungary is a paradise for program pirates. This situation also makes software export difficult for a significant number of the foreign contacts take place in the form of compensation. It is difficult to increase export if the trust of the partner is not complete.

On the basis of the lessons of the picture outlined above Novotrade has committed itself to a surprising undertaking: It will sell in Hungary the BECKERbase PC database management system, prepared for Western customers, for 6,950 forints (this is not a mistake, six thousand nine hundred and fifty forints).

A brave beginning is half the battle! So begin wisely! says Horatius. Before we talk about the background to this unwonted initiative on the domestic market let us say a few words about the chief characteristics of BECKERbase.

BECKERbase

The firm Data Becker—which is one of the largest vendors of books and computer programs in the FRG—recently began to sell the program. According to our information it proved to be one of the most successful software products; within a few months more than 6,000 copies had found owners.

The chief virtue of the program, made for IBM PC/XT, AT and compatible machines, is that it is a very efficient and at the same time compact database management system which can be easily learned and used even by those less experienced in computer technology. Records can be built up with the aid of the DDL (Data Definition Language) high level programming language. Data and field structures can be determined with 12 commands. The most important properties of BECKERbase PC are: fast file management, simple file assignment and creation, the possibility of handling assorted record types simultaneously, simple screen management and printing, net database structures which can be defined without limit, simple creation of logical structure with the aid of the DDL language which describes the structure of the database, a built-in text editor, an environment dependent help system, and a high level programming language called TDL (Transaction Definition Language) to prepare user programs. This latter language resembles BASIC and contains 80 instructions and 18 built-in functions. Its instructions include support for windows and generation of a forward-backward menu structure. The program messages, error indications and help information are in the Hungarian language. They also prepared a Hungarian language user's manual which, according to Peter Vero, is even more extensive than the original documentation.

The First Swallow and the Others

Since 1985 the Novotrade company has had rather close business contacts with the Data Becker firm. Up to now this has meant Hungarian software export and, partly in compensation for this, publication in Hungary of professional books which had appeared in the FRG. BECKERbase PC is the first of the products of the Data Becker firm to be sold here as a program. Even this is not a "real" import, because they obtained domestic distribution rights only for programs they prepared themselves. The real import will come later. According to information from Janos Muth they hope to buy a lot of PPC [professional personal computer] software directly from American and English software houses. The import software will be sold—in Hungarian versions—at substantially lower prices than at present. Each item will be accompanied by a Hungarian language manual, and they will take care of training and support. When new versions appear the more developed version will go to users at a fraction of the purchase price.

This is not just a wish. It is a suitable guarantee of it that Novotrade has successful business contacts with a number of Western firms, including the American Borland, Ashton-Tate and Atari. It is to be hoped that after the

export successes the import also will be ever more significant. We are informed that Datamat Plus 128 will be next, to be followed by a number of quality PPC software products.

8984

GDR: 256 Kilobit DRAM

25020001b Budapest
COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 16, 12 Aug 87 p 3

[Text] Do not fall behind! This is the slogan of the GDR semiconductor industry. It is true that at present they follow the Western countries using developed technology at a distance of a few years, but their goal is a gradual increase in element density. Their 256 kilobit DRAM store has been made in this spirit; they would like to begin mass production of it in 1988 in Erfurt. At present there is series manufacture of 64 kilobit stores at VEB Kombinat Mikroelektronik. But according to information obtained at the Leipzig fair it is not impossible that a megabit dynamic RAM store will be made in the GDR before the end of the decade.

8984

Yugoslavian 32-Bit Computers

25020001a Budapest
COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 16, 12 Aug 87 p 3

[Text] Beginning in the fall the Klagenfurt office of the Yugoslav firm Iskra will begin selling 32 bit computers, according to the Reuters news agency. At present the machines, answering to the name Trident, are assembled with Intel 80286 and Motorola 68010 microprocessors but the new design will be based on 80386 and 68020 types. The more powerful machines will be supplied with the Xenix operating system and IRMX basic software. Later they will also sell MicroVAX type machines, Iskra Delta Computers announced.

8984

MICROELECTRONICS

Hungary: Thermal Oxidation, Intrinsic Gettering in Silicon

25020008 Budapest HIRADASTECHNIKA in Hungarian No 8, 1987 pp 353-356

[Article by Zoltan Manyoki, Microelectronics Enterprise: "Thermal Oxidation of Silicon and Intrinsic Gettering"]

[Excerpts] Summary

The use of intrinsic gettering is spreading more and more in complex IC technologies. The interaction of this procedure with other technological steps is still to be

clarified. The author made an attempt to discover the connection of thermal oxidation and intrinsic gettering. He found that there is a need for long duration secondary gettering heat treatment and that the carbon content of the crystal increases the precipitation of oxygen. There is a correlation between the life expectancy of the minority charge carriers and the degree of precipitation.

Experimental Studies and Characteristics of the Samples Used

We used five gettered and five ungettered wafers for the experiment. The gettering heat cycle was optimized for the minimal wafer curvature. The parameters were as follows:

—1100 degrees C, 6 hours, in an N₂ atmosphere, —800 degrees C, 6 hours, in an N₂ atmosphere, —1100 degrees C, 6 hours, in an N₂ atmosphere.

For the comparative studies we selected pairs of wafers with the same initial oxygen and carbon content which were comparable in their other parameters as well. The following table gives the data on the samples pertaining to various contaminants:

Heat treated wafers are identified A1-E1; those not heat treated are identified A2-E2; the [O]_i*10¹⁷cm⁻³ values are given before and after heat treatment; the [C]_s*10¹⁶cm⁻³ values are given where applicable, for the first two samples in both categories these values are below what could be demonstrated

Identifier	O before	O after	C
A1	10.4	9.0	n/a
B1	5.4	5.3	n/a
C1	5.9	5.3	2
D1	8.3	6.0	2
E1	6.2	5.7	2
A2	10.8	—	n/a
B2	5.3	—	n/a
C2	6.3	—	2
D2	8.4	—	2
E2	6.7	—	2

In their initial states all the wafers were dislocation free. Their Al, Fe and Cu content did not exceed the 10⁻⁹g/g level.

The samples were paired as follows: A1-A2, B1-B2, C1-C2, D1-D2 and E1-E2. The samples designated with a 1 received gettering heat treatment. Those designated with a 2 were control wafers.

Comparing the test results pertaining to members of a given pair makes it possible to judge the effect of the heat treatment; the results pertaining to different pairs make it possible to judge the effect of the base material parameters. We modeled the thermal oxidation with the

ASTM standard OXITEST test. This is somewhat longer than the thermal oxidations used in customary technologies, but it is very suitable for a study of oxidation induced crystal faults because, due to the long duration, the faults caused by it are larger and thus easier to observe. The parameters of the oxidation were as follows:

—heating up: from 25 degrees C to 1150 degrees C, 35 minutes, —maintaining heat: at 1150 degrees C for 120 minutes, —cooling down: from 1150 degrees C to under 600 degrees C, 90 minutes.

The operation took place in an oxygen atmosphere containing water vapor. The gas flow was 100 liters per hour. An oxide layer one micron thick developed on the surface of the wafers. We performed the following tests in temporal order on the oxidized samples:

—after removal of the oxide layer we determined the interstitial oxygen and substitution carbon content of the crystals with the Perkin-Elmer Model 580 infrared spectrometer of the TKI [Telecommunications Research Institute],

—the intrablock crystal faults in the samples were determined at the MTA MFKI [Technical Physics Research Institute of the Hungarian Academy of Sciences] with the X-ray topographic method,

—the measurement of the intrablock recombination life expectancy of the minority charge carriers was done with the microwave absorption method using the LTA-130A equipment, manufactured by M. SETEK, of the MTA MFKI,

—the surface crystal faults were brought out by Wright-Jenkins type preferential etching.

The literature (a thesis by Zoltan Manyoki, Budapest Technical University, 1985) provides a more detailed review of these methods.

Results and Their Evaluation

The amount of interstitially dissolved oxygen in the crystal can be measured with infrared spectroscopy. Thus one can conclude the precipitation of oxygen from a decrease in this. It is true that during the heat treatments a part of the dissolved oxygen diffuses out from the wafer, but the amount of this is small compared to the decrease noted in the quantity of interstitial oxygen. This can be easily seen because if during the diffusion of oxygen a completely denuded zone (that is, one impoverished of oxygen) is exhausted the concentration reduction corresponding to this is proportional to the original concentration as twice the depth of the denuded zone is to the thickness of the wafer. And this falls within the order of magnitude of the measurement precision.

The following table contains the concentration values measured after oxidation and the decrease compared to the initial concentrations, designated minus delta:

The first figure gives the value of $[O_i] \cdot 10^{17} \text{cm}^{-3}$ after oxidation and the second figure gives the value of minus delta $\cdot 10^{17} \text{cm}^{-3}$

Identifier	After oxidation	Difference
A1	8.0	2.4
B1	5.3	0.1
C1	5.5	0.4
D1	5.0	3.3
E1	5.3	0.9
A2	9.9	0.9
B2	5.5	0.0
C2	5.6	0.7
D2	6.0	2.4
E2	6.0	0.7

In the case of the heat treated samples the concentration decrease is partly the result of gettering heat treatment and partly the result of precipitation during oxidation. In the case of the samples not heat treated only the oxidation could have caused the precipitation. Figures 1 and 2 show the degree of precipitation as a function of the initial oxygen concentration. A different symbol designates the values for crystals containing carbon and those "not containing" carbon. Knowing the carbon concentration is important because according to some authors the carbon atoms form nucleation centers for the precipitation of oxygen and so accelerate the process. According to other authors, on the other hand, carbon plays no role in the precipitation, which is determined solely by the oxygen atoms, the vacancies and the interstitial silicon atoms. According to still other authors the carbon slows the nuclear formation of the precipitates and thus the precipitation. The literature gives a good review of these opinions ("Defects in Semiconductors" edited by J. Narayan and T. Tan, New York, 1981). It is obvious that this question still needs to be clarified. It can be seen from the measured values that the precipitation is more significant the more oxygen the wafer contains at the start. This is true whether there was little or more carbon in the silicon, but in the latter case this dependence is steeper. So we can state that the carbon aids the precipitation of oxygen, so it is worth using wafers containing at least $2 \cdot 10^{16} \text{cm}^{-3}$ initial carbon for efficient intrinsic gettering.

Figure 1 also shows separately the degree of precipitation during oxidation in the gettered samples. It can be seen from this that the gettering heat treatment substantially reduced the precipitation during oxidation only in the sample with a high oxygen and carbon content (D1), the consequence of which was also observable in the result of the preferential etching test. The relatively insignificant effect of the gettering heat treatment observed in the other samples can probably be attributed to the shortness of the second heat treatment. Indeed, as we already mentioned, the preliminary heat cycle was optimized to

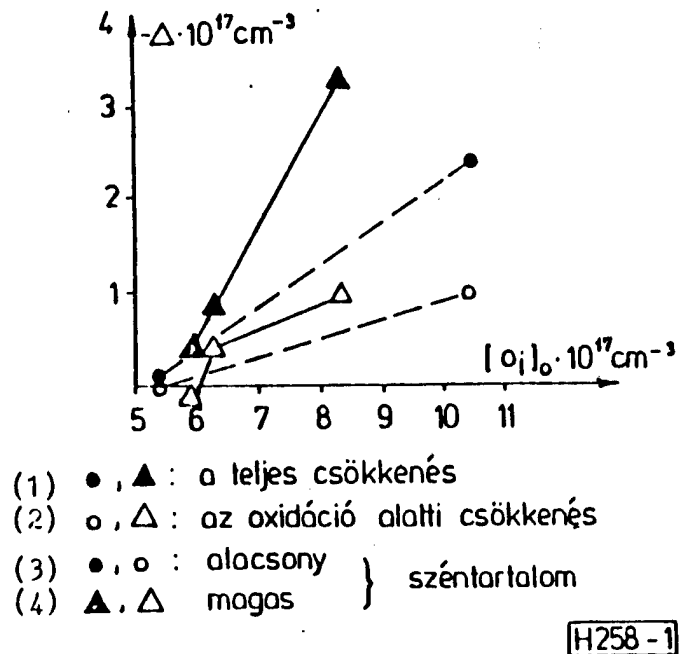


Figure 1. Degree of precipitation as a function of initial oxygen concentrations in the case of heat treated samples.

Key:

1. The total decrease
2. Decrease during oxidation
3. Low carbon content
4. High carbon content

the minimal wafer curvature. Since only a moderate amount of gettering caused the change it is obvious that during the nucleation (second) step few new nuclei came

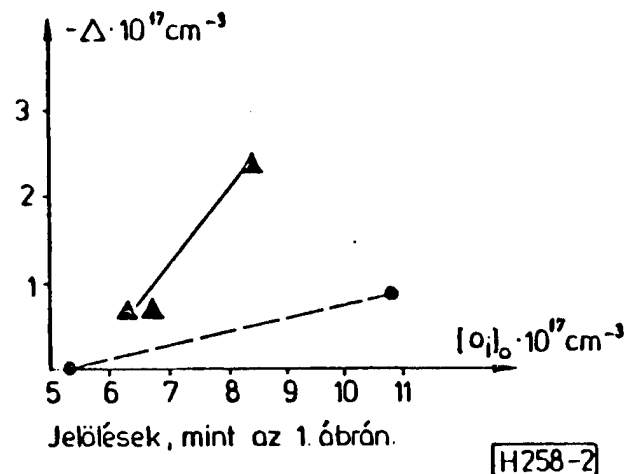


Figure 2. Degree of precipitation as a function of initial oxygen concentrations in the case of samples not heat treated. Designations as in Figure 1.

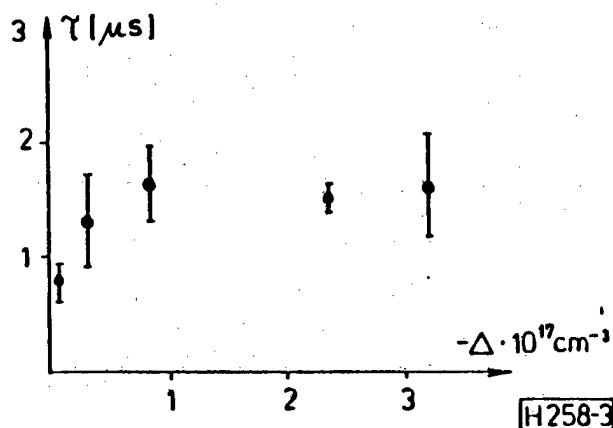


Figure 3. The life expectancy of the minority charge carriers as a function of the degree of precipitation in the heat treated wafers.

into being compared to the so-called "as grown" precipitate nuclei arising during crystal growth, and this points to the briefness of the nucleation phase. It can also be seen that when the oxygen concentration reaches the range of $5 \cdot 10^{17} \text{ cm}^{-3}$ any further precipitation slows down, or even stops. This can be attributed to the fact that at the temperatures used the balance concentration of the interstitial oxygen is around the cited value, so upon reaching this the supersaturation, the driving force of precipitation, ends.

Two different methods had to be used to show the crystal faults. Faults within the block material could be shown with X-ray topography and those on the surface could be shown with preferential chemical etching. Fitting faults were found in the block and on the surface in both the heat treated and untreated samples. The X-ray topography also showed large scale (between 20 and 30 micron) precipitates, but only inside the heat treated wafers. The density of these was relatively small. Naturally precipitates formed in every sample, the results of the infraprecipitation study showed this, but obviously the size of these was much smaller than that of the large precipitates mentioned and so they could not be demonstrated by X-ray topography. The difference between the heat treated and untreated wafers was not in the fault density and size but rather in the distribution of the faults. The sample D1 constitutes an exception; there were hardly any fitting faults on its surface. As we mentioned already the initial oxygen and carbon concentrations in this crystal were both high. So we got a result agreeing with the infraprecipitation results. The surface fault distribution of the heat treated wafers was even but it was uneven and spotty in those not heat treated.

The information about the factors discussed thus far—oxygen precipitation and crystal faults—acquires meaning if we relate them to an electric quantity which can be evaluated from the viewpoint of the final product, the

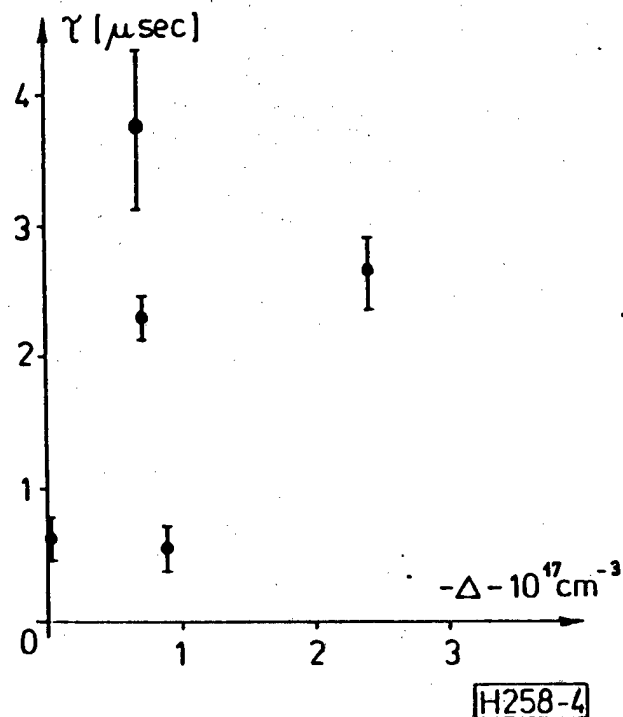


Figure 4. The life expectancy of the minority charge carriers as a function of the degree of precipitation in the wafers not heat treated.

IC. This electric characteristic must be such that it can be measured without forming a device structure, for the technological steps necessary to form a possible structure might obscure the phenomenon or interdependence we want to study. The intrablock recombination life expectancy of the minority charge carriers is such a characteristic electric parameter, because this is of determining importance in the case of many devices and a method to measure it not requiring a structure is known, based on a measurement of microwave absorption. The intrablock recombination centers, the crystal faults and their density, determine the intrablock recombination life expectancy which can be thus measured. Figures 3 and 4 depict the life expectancies measured as a function of the degree of precipitation. It can be seen that in the wafers not heat treated this life expectancy shows no correlation with precipitation, and further that in general the values measured in these samples are greater than those measured in the heat treated samples. This is understandable because the heat treatment created faults where the life expectancy measurement was done. The lack of correlation observed in the untreated wafers can be explained by the differing origin and previous life of the samples, because of which the amount and nature of the built-in, already mentioned "as grown" faults also differ. The first step of the triple heat treatment represents a sort of homogenization, so the significance of the differing origins diminishes.

Naturally not only the fitting faults and the oxygen precipitates can cause recombination; it can also be caused by microfaults which could not be shown with the methods used.

Although the studies cannot yet be regarded as concluded the results thus far prove that it is worth using crystals with high initial oxygen and carbon contents in the interest of the efficiency of intrinsic gettering. In the case studied the heat treatment step aiding nucleation proved to be brief. The bulk recombination life expectancy of the minority charge carriers could be used well as an electric grading parameter of the processes. This life expectancy showed a correlation with the degree of oxygen precipitation.

Biographic Note

Zoltan Manyoki graduated in technical physics from the Electrical Engineering School of the Budapest Technical University in 1985. He is still a day student in special engineering there as a worker of the Microelectronics Enterprise. The theme of his work is a study with physical methods of process induced crystal faults.

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Hungary: Views, Career of Prize Winning OMFB Official

25020003b Budapest *MAGYAR ELEKTRONIKA* in Hungarian No 8, 1987 pp 3-5

[Interview with Jozsef Budinszky, a main department chief in the OMFB (National Technical Development Committee), by Zsuzsa Kardos]

[Excerpts] [Question] You have been awarded the Eotvos Prize in recognition of your work in the development of the domestic electronics industry. What was your first thought when you learned of this?

[Answer] I am afraid that the answer will be stereotyped but I must begin by saying that I feel it a great honor to have been found worthy of receiving the Eotvos Prize. Complete sincerity demands that I say that my past and present colleagues have had a crucial role in my professional activity, its various phases and successes. All I can call my own, what I might praise myself for, is that I always selected my colleagues well; I always succeeded in putting together good teams out of younger and older colleagues. I also consider myself fortunate in this respect, that in the course of my two decades of industrial research and development work in industry and during my nearly 15 years of work in the OMFB I could always make my own choices, practically without limit, which is not an everyday or self-evident opportunity. Beyond the fact that I had such an advantage in the first phase of my career, in industry, during the years at the Mechanical Laboratory, this opportunity even expanded further during my time in the OMFB. It is also well known that the OMFB is an organization with a very

anti-Parkinson structure, its own apparatus is very small, it brings into its work the best experts of the country to advance technical development—a fundamental thesis for collective wisdom. So I always had the opportunity to ask for the best domestic experts, bring them in to the solution of my tasks, to work with technical experts active in the Academy, the universities, ministries, various institutes and enterprises in coordinating developmental studies and to exchange ideas with them in questions of technical development and the financing of it.

Early in my career my basic task became research work in the area of reception technology for professional communication. In the course of this it was a unique motivation that practically without a basic professional literature background, in the absence of this, we had to develop very modern equipment and systems and put them into manufacture. Such a theme represents a rare exception; in most cases the approach giving the more efficient and more modern result is research and development work based on an exhaustive consumption of the professional literature. It is always a great temptation to electronic engineers to discover something much more convenient and enjoyable than to correctly summarize the literature and the foreign achievements. In the majority of R&D themes the latter method requires greater intellectual effort, discipline and fatigue. But if there is no access to it then we have a right (and virtually only then do we have it) to discover something which may have been discovered elsewhere already. Despite the difficult theme and the objective difficulties I worked, with outstanding colleagues, in an outstanding atmosphere, and we all felt that we were creating, vertically, a new and important technical area within the electronics industry. The joint work resulted in a number of joint patents which stimulated domestic technical development for more than two decades.

[Question] You joined the National Technical Development Committee nearly 15 years ago, to work on communications engineering, telecommunications and electronic parts. How did you react to this?

[Answer] Despite all the obvious difficulties I was happy to make a "career modification." I felt that I could use my industrial experience profitably in this assignment. I joined outstanding colleagues and very experienced technicians; I was also fortunate to be able to work under the direction of Dr Miklos Ajtai, whose human greatness had a profound effect on me and who, unfortunately, departed the ranks of the living too soon.

[Question] Please tell us about your activity in the OMFB!

[Answer] My work—similar to the work of my colleagues representing other branches—can be divided practically into four large areas. The traditionally primary task is preparation of technical development studies, sometimes preparation of conceptions, and coordination of

the work of experts, in order to develop some important areas. Discovering technical development tasks of a longer range and interdisciplinary character, and working out these developments, constitutes a special point of emphasis in the work of preparing studies.

Supporting, providing financing for, various technical development goals is an important part of my work. The importance of this activity is constantly increasing; using competitions and a bank approach or system it moves things in the direction of a practice seeking the optimal undertaker of the task.

In technical development policy and in questions connected with this the OMFB is an advisor to the government, so offering an opinion on proposals in this area and sometimes development of independent proposals is a virtually continual task for workers at the OMFB.

We have a very important task in encouraging international cooperation, in both the socialist and developed capitalist relationship, in the interest of technical development. I might say that going beyond the coordination tasks we must also carry out the difficult and not always thankful task of a "matchmaker." In the majority of our international activities the ultimate goal is to develop direct, mutually advantageous contacts between domestic and foreign enterprises and institutions, cooperation which will advance domestic technical development.

[Question] After this general description, let us turn to your narrower area!

[Answer] I feel that for a number of reasons it would not be useful to bring out here and now that important and comprehensive work summed up by the Economic Development Program for Electronification and the R&D programs which support it. The electronification program embraces a broad spectrum, it has been publicized in detail and in many places already, and it goes beyond the work of myself and my immediate colleagues. Permit me, instead, to express a few comprehensive thoughts, more precisely to formulate the thoughts of many of our domestic experts, in connection with our problems for further development.

I am convinced that a selective dynamic development of our industry is absolutely necessary for our economic evolution. And electronics must provide the driving force for this.

The electronics industry proved its vitality during the Sixth 5-Year Plan, even in a more restrained economic environment. Its results were outstanding compared to the average growth of both net production and ability to produce income.

We are constantly modernizing our economic guidance, we try to derive an example from everything in the world which can be evaluated as positive, but at the same time we make ourselves blind to the fact that in both the

socialist and developed industrial capitalist countries great preference is given to the electronics industry—as a determining driving branch—over and above all the normative rules of the game. I am also convinced that in our country there are sober and rational limits to the ideology of "small is beautiful"—for all its indisputably positive aspects.

After these more comprehensive statements I would like to publicize a few developmental "dabs" on which my colleagues and I have worked a lot recently, or are still working on.

The OMFB has given many-sided support, in good time, to R&D work pertaining to teletext transmission; thus, with a small investment, the video newspaper service can start in our country as the first among the socialist countries, and there are also plans for additional specific exploitation of it.

With R&D and license adoption support for hybrid integrated circuits the OMFB has contributed significantly, for more than a decade, to the fact that domestic manufacture in the area primarily of thick film hybrid circuits stands at a good level in regard to resistance; there was practically no need for capitalist import in this product category and by the end of the present plan period there will be a total production value capacity of half a billion forints for the manufacturers of electronic equipment.

A national (and soon international) paging service is spreading swiftly in Western Europe. Special UHF transmitter networks are created for this which transmit selective calling codes for pocket size paging devices. The OMFB espoused an innovation by researchers at the Hungarian Post Office and the BME [Budapest Technical University] which provides this service with the existing program broadcasting, without a UHF transmitter network. This new service can supplement the telephone service in areas especially poorly supplied with telephone networks. We plan to use this procedure to send short "telex" texts to terminals located anywhere in the country, without using wires.

Since the end of 1979 we have regarded it as a timely and important task to aid the domestic production and broad use of optical digital transmission systems. Two experimental sections for postal trunk transmission purposes are in operation—with the aid of import. There is still much to do in other areas; research is proceeding at a good level for production of the necessary GaAs laser diodes and detector diodes in various wavelength ranges. The situation is reassuring in the area of the necessary PCM multiplex equipment; there are failures behind us in other areas, and much remains to be done. We see great opportunities for optical systems in the realization of broad band LAN's for various purposes, in addition to professional postal links.

What has been said represents only a few samples of the work of the OMFB, of my colleagues and myself, only a taste of the whole.

I very much hope that in well coordinated cooperation with the ministries and organs with national authority we will be able to work out an arrangement in which electronics, its broad use, and a selective dynamic development of our electronics industry will have a stimulating effect on the modern development of our entire economy.

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Hungary: Spectrum Transformations With DFT Filter Banks

25020003d Budapest MAGYAR ELEKTRONIKA in Hungarian No 8, 1987 pp 19-27

[Article by Jozsef Elekes: "PCM/FDM Spectrum Transformations With Polyphase DFT Filter Banks"]

[Excerpts] The task of transmultiplexer equipment is to link PCM and FDM systems. The article deals with digital realization of the necessary filter banks. It describes the computational methods and defines the hardware needed for realization.

Summary and Conclusions

In the article we described computational methods for a PCM/FDM transformation based on polyphase DFT banks and derived multiplication expressions for a quantity—by channel—characterizing the computational complexity of the system.

On the basis of Table 1 one can estimate how many LSI hardware multiplication circuits will be needed to realize a given system. Circuits representing peak technology today are capable of multiplying together two 16 bit data in 100 ns (ten million multiplications per second). For example, four multiplying circuits could satisfy the multiplication needs of a 64 channel DFT bank ($64 \times 0.576 \times 10^6 = 36.8$ million), while two could do so for an O^2DFT bank. (The multiplication need of the latter is 12.6 million per second.) We should note that in the case of the FIR structure presumed in our analysis it is customary to choose a more economical basic filter type in practice, and when realizing branch filters there are also procedures reducing the computational requirement. By using these a 64 channel O^2DFT bank could be realized with a single hardware multiplier.

Table 1. Multiplication numbers needed by channel for PCM/FDM transformations

Bank type	Channel Number (K)		
	14	64	128
DFT _K	558400	576000	584000
GDFT _K	326000	344000	352000
GDFT _{2K}	434400	452000	460000

Table 1. Multiplication numbers needed by channel for PCM/FDM transformations

	Channel Number (K)		
	194400	212000	220000
O^2DFT	194400	212000	220000
DFT _{2K}	418400	436000	444000

Finally we call attention to the fact that the computational complexity in itself does not characterize the complexity of the equipment as a whole. In general it can be said that we must pay with complexity of control for a reduction in the computational requirement. Thus different bank types represent the combined optimum—as a function of channel number.

Autobiographical Note, Jozsef Elekes

I earned my electrical engineering degree and my transmission technology special engineering degree at the Electrical Engineering School of the Budapest Technical University in 1961 and 1966 respectively. I have been a scientific worker at the Telecommunications Research Institute since 1962 and am now a senior colleague. At present I lead the analog signal processing department of the institute. My specialities are systems technology for landline transmission equipment and digital processing of analog signals. My research themes are transmultiplexer equipment and automatic monitoring systems for FDM equipment.

8984

Hungary: Role of Physics Institute in Microelectronics Research

25020004a Budapest FIZIKAI SZEMLE in Hungarian No 5, 1987 pp 162-166

[Article by Ivan Szep, MFKI (Technical Physics Research Institute): "Thirty Years of the Technical Physics Research Institute of the MTA (Hungarian Academy of Sciences)"]

[Excerpts] In accordance with science policy goals the chief direction of the "Solid Bodies Research" of the National Long-Range Scientific Research Plan starting in 1971 was aimed at development of new materials and products, so our institute reduced the earlier phenomenon-centric themes and planned research aiding the creation of new products serving domestic technical development, in many cases posting the goal of developing concrete products. In this period semiconductor research was concentrated on GaAs and GaP based film structures, on the electroluminescence phenomena which can be produced in them, and on a study of domain processes, as a result of which methods for the production of GaAs and GaP based "illuminating diodes" were developed, with parameters approximating the level of commercial products.

For the purpose of making concrete industrial products the researchers at the institute developed a technology for oscillating diodes in the 10 GHz range on the basis of the domain migration which can be created in gallium arsenide, in addition to making a number of new discoveries concerning the creation and physical properties of metal-GaAs contact systems.

In the area of metal-insulator-semiconductor systems studies began on the technology and properties of silicon based charge retaining structures serving memory purposes. By the end of the plan period these projects concluded with preparation of working integrated model circuits.

Tungsten technology research in this period extended to a study of the role of formation conditions and a study of the effect of foreign inclusions (oxide, carbide) which could be demonstrated. There was more and more evidence that the porous strings which could be seen at high magnification in the fiber boundary of large crystal tungsten wire had a determining role in the development of the fibrous structure. It was possible to demonstrate by X-ray spectroscopy with the aid of a 0.1 λ m cross section electron beam, with a precision of 10^{-17} g, the statement from the professional literature that the pores contain metallic potassium.

With thermodynamic calculations of the chemical reactions taking place between the gaseous additives (halogens, carbon, oxygen) present in gas filled tungsten lamps and the incandescent tungsten filament it was possible to derive the material transport laws which are determining in the operation of the lamps and, on the basis of this, to develop halogen filled light sources with more favorable properties.

By developing a modern X-ray chamber design it was possible to significantly improve the capacity of X-ray topography methods which play a key role in study of fault structures in silicon crystals.

By the middle of the 1970's it became increasingly urgent to modernize the technology of the domestic steel industry and ferrous metallurgy. The MFKI joined in this activity. For example, it cooperated in introduction of the solid electrolyte cell method to determine the oxygen content of steel melt and developed, and installed in the Danube Iron Works mill train, an automatic mill train control providing a flat lay to eliminate the deformation of rolled steel sheet.

Research aimed at discovering and using new physical phenomena was not neglected even with the research serving practical goals. On the basis of studies done with so-called acoustical surface waves which can be created with an electric field on piezoelectric materials the researchers of the MFKI developed, with the aid of appropriately scaled combing electrode systems, high frequency filters out of lithium niobate crystals produced in the Crystal Physics Research Laboratory of the MTA.

These have been used successfully in domestic TV sets and the Communications Engineering Industrial Research Institute took them over for manufacture.

In the area of new measurement techniques the researchers of the institute further developed the Auger electron spectroscopy method, which is used successfully to study tungsten, molybdenum and steel fracture surfaces.

The sphere of light source photometry was substantially expanded in that the researchers at the institute developed, on customer order, a number of instruments to measure, for example, light intensity distribution and color. The microprocessor controlled lamp testing photometer proved to be a design which could be sold independently and even foreign customers have ordered the goniophotometer.

The development of materials technology made necessary the measurement of new parameters not studied earlier and the instruments needed could not be obtained commercially. In this situation it proved to be a good idea to develop such instruments and equipment in the form of finished products. Outstanding among these is the deep level spectrometer, which has won success even on the international market and with which one can determine the characteristic energy value, concentration and spatial distribution of contaminating atoms and lattice faults which harmfully influence electric charge flow in semiconducting materials. Researchers at the institute developed the instrument jointly with colleagues from the Central Physics Research Institute and the RADELKIS cooperative manufactures it.

Among the industrial areas backward in technical development in the middle 1970's the situation of the domestic microelectronic parts industry became increasingly glaring. For this reason an LSI research and development association was formed with the participation of four research institutes for the primary purpose of accelerated development of a modern technology for large scale integrated circuits and doing exploratory research to create a few specific microelectronic products (memories, microwave and optoelectronic elements). Researchers from the MFKI carried out considerable work in this alliance, for example in the development of a technology for semiconductor memories which retain information (FAMOS, MNOS), developing gallium arsenide based microwave mixing diodes and in fault diagnostic testing systems for integrated silicon circuits.

In addition to our contacts with domestic industrial enterprises there began in these years an extraordinarily fruitful technical-scientific cooperation with the Berlin enterprise Werk fur Fernseh elektronik, which made possible direct utilization of the experience gained in optoelectronic research. Studying the efficiency and degradation of illuminating diodes the MFKI significantly contributed to a further development of manufacturing

technology. The institute developed a number of special instruments for these studies and to determine the photometric data for finished products.

The National Medium-Range Research and Development Plan which started in the Sixth 5-Year Plan put new tasks and new opportunities before the institute. We undertook to cooperate in three programs: the material and energy conserving technologies program, the micro-electronic parts technology program and the material sciences and technologies program. As is well known the interested industrial enterprises also joined in these programs, which was intended in principle to aid a swifter utilization of new developmental achievements. Unfortunately this supposition did not prove to be true.

The restrictive financial policy of 1980-81 cut back investments drastically and it became virtually impossible to get instruments and equipment from the capitalist market. The reduction in personnel forced on the Academy research institutes hindered planned researcher training and a development of personnel proportional to the tasks. All this caused temporary hitches and forced changes of course in the activity of the institute. The fate of the gallium arsenide crystal growing laboratory, planned in the material sciences program, is characteristic. Every obstacle to acquisition of the crystal drawing equipment has been overcome but the denial of an import permit frustrated the entire deal and thus the entire program. Production of marketable products within institutional frameworks and development of industrial technologies which could be used immediately became increasingly necessary to supplement the dwindling research support. But for all this, in this period also, there were research achievements based on new ideas such as development of the redox-catalytic process for removing the molybdenum core from tungsten spirals and, within the framework of the developmental program for material and energy conserving technologies, obtaining valuable cobalt, tungsten and tantalum from hard metal waste with an electrochemical method. The development of a technology which spares the environment, one based on entirely new principles, was started with use of electrodialysis and solvent extraction. This will be discussed in greater detail later in the session.

Going beyond the production of microwave parts based on gallium arsenide the institute also joined in applications technology tasks. With the development of a Doppler module, oscillator assembly it aided the realization of significant industrial and safety goals.

The institute participated in the space research "Eotvos Program" organized by the Interkozmos council; it prepared samples and fittings for the production of gallium arsenide and gallium antimonide monocrystals under microgravitation conditions and it evaluated the results.

Despite the dropping of the monocrystal laboratory we sought and found a way to conduct the planned experiments in cooperation with the MASPEC research laboratory in Parma, where the Czochralski process was used to produce good quality gallium arsenide monocrystals. Here at home experiments have begun to realize a modern version of the Bridgman method. Recognizing the growing importance of the composite phases of $A^{III}B^V$ type compounds experiments have been done to produce ternary, quaternary and pseudoquaternary mixtures.

The spread of light conducting telecommunications systems which can be experienced throughout the world also put research on their components on the agenda. Development of production methods for gallium arsenide based laser diodes has begun within the framework of the microelectronic parts program; researchers at the institute have developed test methods and tools to determine the physical parameters of light conducting fibers. There has been substantial progress in obtaining technological equipment suitable for epitaxial film growth of $A^{III}B^V$ compounds. By purchasing a Soviet license we obtained plant equipment and know-how suitable for vapor phase epitaxial growth of gallium arsenide; we improved the experimental conditions for liquid phase epitaxial growth with domestically developed equipment and equipment of Swedish origin.

Unfortunately the improvement in technological equipment succeeded in only a few places. If we consider that the second round OKKFT [National Medium-Range Research and Development Plan] programs had as a goal the modernization of a number of industrial branches and the creation of new industrial branches within a short time then we cannot regard our conditions as satisfactory. The technical value of our machine and instrument inventory is 50 percent—the average of 75 percent for a few very valuable instruments and 25 percent for many instruments of little value. Under these conditions our contribution to the national electrification program or to new technologies which spare the environment can be effective only with a renewal of a considerable part of our fixed assets. We can join in international cooperation, such as the CEMA complex development program planned for the year 2000, only after very careful consideration.

So this situation obviously cannot be called reassuring. But looking back on the 30 year activity of the MFKI perhaps I have succeeded in showing that even before this our institute was not exactly the darling of fate. Still I can say without prejudice that in the difficult situations the leadership and working collective of the institute always found a solution to ensure the continuation of research work, beginning with the modernization of themes and posting new timely tasks which could with great probability be carried out in the given situation all the way to ensuring the finances needed for operation. At the time the tasks formulated in the charter prescribed basic research connected with products of the vacuum

technology industry. With the passage of time this proved to be too narrow a sphere of activity; the institute did not hesitate to develop new theme areas in the area of the physics and technology of solid bodies and semi-conductors. Following the formulation of the national goals for technical development it moved on in the direction of developing new industrial products and technologies and then, sensing the frequent deficiencies in industrial receptivity, it also undertook production and applications tasks, and even entered into production cooperation projects.

All this aided the direct utilization of research achievements, but it must be noted also that to a certain extent new research tasks were forced into the background. This involves the danger that insufficient capacity and time will remain for the creation of new technical solutions and technical-scientific discoveries. During the past 30 years the researcher personnel of the institute have increased from the initial 35 to not quite 100; the size of the headquarters does not permit further expansion. So it seems useful in the future to entrust non-research activity to various associations and to concentrate greater forces than at present on the solution of immediate research tasks. Technical research is a key question for the structural renewal of our industry; our institute wants to participate in this with the solution of tasks worthy of its past.

Among the tasks set forth in the charter let me refer briefly in conclusion to our international contacts; in addition to what I have already mentioned there are contacts with similar institutes in twelve countries, ranging from periodic exchange of information to joint research projects extending over many months. The publishing diligence of our researchers is also worthy of recognition; during the past 30 years there have been nearly 3,000 articles which were published in trend setting international journals or in the form of patent descriptions. Summaries of the work can be obtained in monographs published by the institute, and since 1977 in Hungarian and English language yearbooks. Of the 100 researchers of the institute three are doctors of science, 25 are candidates in science and 20 are university doctors. The institute participates in graduate training and as a designated research site in the training of young scientists. But perhaps there have been enough statistics!

Thirty years ago I myself assisted at the birth of the MFKI; I guided the first steps of the young designate researchers in my speciality. Since then the institute has developed into one of the most significant base institutions for domestic technical research, one enjoying fame even abroad. Compared to research institutions which customarily concentrate on one or another special area the MFKI appears to be an extraordinarily heterogeneous organization thematically. But perhaps it is this heterogeneity, changing even within itself and capable of always accomodating to external conditions, which

maintains the interdisciplinary impact within the institute and helps the swift determination to abandon a theme which ceases to be interesting and to start a new one. I think that this is a property which will be indispensable for the successful activity of the next 30 years!

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On Our Cover

The graphic on our cover represents digital signal processing. Naturally a graphic representation is difficult in the case of such a complex theme as signal processing. The digital technique, spreading more and more today, has already gained ground in many areas of electronics, including communications technology. Filtering is a significant area within telecommunications. In Hungary the workers at the Telecommunications Research Institute have dealt successfully with it for years. Our compilation gives a taste of this work.

Signal Processing

We have gathered under the heading "Signal Processing" articles by the authors' collective of the TKI [Telecommunications Research Institute]. Denes Fazekas gives an example of realization of digital filters using the Intel D-2920 signal processing microprocessor. Jozsef Elekes writes about PCM/FDM spectrum transformations realized with DFT filter banks. Maria Szilvasi (Mrs Nagy) gives an example of realization of a digital IIR filter. Andor Dobrovits discusses the question of electromagnetic compatibility (EMC) in electronic equipment. The summary by Julianna Orosz (Mrs Foldvari) about the digital signal processing program package adopted at the TKI appears in the "Further Training" column.

Panorama

In our "Panorama" column our readers will find a summary of 32 bit microprocessors being manufactured today, on the basis of an article in ELECTRONIC DESIGN. The article not only compares the chief properties of existing types, it also provides a brief description of developments in progress. Although use of 32 bit processors in our country is still limited today it is worth turning attention to the development of this theme area, and to the problems accompanying development.

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SCIENCE & TECHNOLOGY POLICY

Academician Critical of National Scientific Research Fund

25020005 Budapest MAGYAR TUDOMANY in Hungarian No 7-8, Jul-Aug 87 pp 581-583

[Article by Academician Dezso Kiss, Deputy Director of the Central Research Institute of Physics (KFKI) "How I See the National Scientific Research Fund (OTKA) Today?"]

[Text] I am glad that it exists. From the beginning I favored the jury-system of awarding research contracts, and within that system I liked the National Scientific Research Fund. As of now, my opinion has not changed; I still think that the forward-looking, positive traits dominate in the Fund's work. What I consider most important about the course we have chosen is that pure research projects are beginning to be recognized, and their chances for survival are improving. (It is quite another story that—even taking another term of the Fund into consideration (that is, until 1995)—the share of pure research projects barely amounts to 15% of research and development (K+F) monies, which is the equivalent of the 1980 level.) At the same time, the overly rigid institutional framework and restriction has loosened somewhat. I am also encouraged by the broad-based and democratic methods used by the Fund in its adjudication, in contrast to past decisions that were

made by individuals at the institutional director level. The critical remarks listed below are not intended to diminish the Fund's basically forward-looking and positive nature.

Slow beginnings: Naturally, it was a problem that we were at the start of a five-year plan period as well as a plan-year, and—since we were waiting for the evaluation of applications submitted to the Fund—we did not foresee the fiscal openings during the initial period. I feel that this is not going to recur, and that in the future *the competition will be announced at least a year in advance.*

Institutional financing - Competitive financing: The sharpest criticism is that the amounts earmarked for the Fund are not separate allocations, but are taken out of money produced by the larger enterprises. Thus, a portion of the money required for the operation of the institutions is taken away from them, and it is not guaranteed that they will receive Fund allocation in the same amount; or even if they do, it will be earmarked for different areas and operational goals than was initially visualized from the point of view of the activities that produced the profits. I believe that the Fund would best fulfill its task, and would become unconditionally accepted by everyone, if its awards are given *in addition* to the usual budgetary items, as *extra allocations*. Of course, this will depend on the country's economic situation, but I feel that it is important to emphasize, because—even if the economic situation remains unchanged—it would be advisable to follow this course during the next series of awards announced by the Fund.

I also feel that the conflicting interests existing between the enterprise leaders and the Fund's specialized directors may give rise to problems. On the one hand, the bidding enterprises would like to have the greatest freedom in effectively using the allocated amounts of money. On the other hand, the central leadership frequently feels that the competitions have taken from the enterprises money which later was returned to them in a form that the enterprises are less able to control and dispose of—even if the entire amount was returned to them. Although, in principle, such conflict is genuine, I am hoping that certain methods will develop that will mutually reinforce the two types of subsidies for research. In my view, it is an unequivocally *positive* aim just to have competition loosen the decidedly rigid institutional framework and compel the national leadership to consider—in the interest of pure research—not only the economic feasibility of institutions, but also the *significance* of scientific endeavors.

I consider it a problem that *investment resources* are distributed by the institutions, rather than by the researcher-collective that won the competition. I understand the reasoning, according to which a given scientific instrument may be better utilized if it is not assigned to one topic or one research team. However, it is not necessarily the only, and perhaps not the most fortunate, solution to make the institutions responsible for the

distribution of such instruments. True, this practice may eliminate certain parallels, but we also infringe upon the Fund's independence in managing projects, and create uneven situations; after all, when it comes to the concrete utilization of the allocated material resources, individuals competing for the Fund's money—rightfully—enjoy a relatively high degree of freedom and latitude. Based on my experiences thus far, I am inclined to make the recommendation (which may change in the future) that the *investment items* should also be controlled by the *grant applicants*, with the concurrence of the institutions' directors.

The fact that research institutions wish to use the Fund's money to cover some of their *operational expenses* represents a separate problem. To a certain extent, this attitude is justified and reasonable; after all, the Fund's researchers use the infrastructures of the institutions and central apparatus just as much as those who are not involved in the Fund's competitions. At the same time, it would not be desirable—and, in my view, it would go against the spirit of the Fund—if operational costs were to place too much of a burden on the Fund. Therefore, I recommend the introduction of central regulations establishing 20% as the maximum allowable level of Fund money to be used for operational contribution.

Hard currency : At the moment, the most important worry seems to be whether or not the awarded research subsidies will contain hard currency, and how much? Without hard currency, of course, the value of awards, and thus the practical usefulness of the entire system, will be reduced. At the same time, I understand that decisions concerning this topic are influenced by the country's circumstances at any given time. If we have, and continue to have, problems with obtaining hard currency, this will affect research, whether they are under the aegis of the Fund or within the institutional framework. Still, I consider this a issue on which the leadership of the Academy *must inevitably take a stand*, in order to obtain a solution favorable for us.

Unnecessary regulations : I feel that the present practice of separating material budget-items and investments in the area of computer technology or infrastructure should be re-considered. It is likely that investments in infrastructure will have to be applied for and evaluated separately in the future, too, and the present form—under which institutions or research centers put in their applications—may be the practical method. One could argue for the separate and emphasized handling of computer investments under the present conditions; but I am not sure that in the future we will have to separate this from the other investment fields. My feeling is that we will have to re-consider this issue around the end of the present Five Year Plan period, when we will have some experience with the applications handled by the Fund. I can visualize that in the future we will have to leave it up to *the applicant himself*, or to the research team, to what degree they wish to use the money awarded them for the purpose of obtaining computer equipment.

I wish to mention a specific problem: there are difficulties *transporting resources and material abroad for experimental purposes* and keeping them out there for extended periods. In the narrow sense, it is indeed in our interest to use the Fund's resources primarily in our country, but it is unacceptable to see that when an experiment is being conducted in collaboration with foreign scientists, the instruments obtained with the Fund's resources cannot be taken outside the borders for longer periods. (By the way, this will be revealed by the applications themselves.)

The judging of applications was fundamentally correct : It was conducted by knowledgeable experts, and took place before broad democratic forums, and thus—to my knowledge—there have been few remarks concerning the objectivity of the process. While the opponents and juries used a completely professional approach in selecting the topics to be subsidized, the scientific departments and sub-committees were in no position to significantly change the ranking order of the applications. Their role was limited to designate certain "cut-off lines," accepting the ranking order given them by lower-level committees (opponents and juries), altering the order in certain exceptional cases, and implementing certain considerations of national scientific policy.

Accountability and assessment : It is a natural consequence of the application system that there must be reports made of the process, and accounts given of available opportunities. Every applicant and every recipient of award approves of this. However, it is worthwhile to *make distinctions* when it comes to the individual cases. There are areas, where yearly reports give a relatively true picture as to the progress and difficulties of the work. Others may have a run-through time of 5-10 years. In these cases, I could visualize bi-annual reports, or even only one *account*, to be given around the time of (just before or just after) the application deadline.

As for finding the optimal method for final evaluation, this is crucial both for the Fund's future competitions and for the professional and moral prestige of the applicants. On this point, we have no experience yet, so we can choose freely. It must be admitted that it is not easy to choose the most correct and objective method. One possible solution is for the evaluation to be accomplished by the same jury as the one that accepted and ranked the applications. This has the advantage that the evaluators know the applications well, and there is no question of their expertise. However, even with the best of intentions it is possible that—in the interest of protecting colleagues—the evaluation becomes twisted to the point where it retroactively justifies the correctness of the earlier selection and ranking. The opposite extreme would be to leave the evaluation to those who themselves applied but were turned down: Certainly, this would yield the most critical evaluation, but—once again—it is conceivable that bitterness over being rejected would not

fully serve the cause of objectivity. Numerous intermediate variants can also be proposed. I believe that we must reconsider this issue, and develop the most suitable method in the next few years. If I had to make a proposal today, I would choose a variant closest to the first method, perhaps modifying it with the suggestion that, after hearing the opponents and the jury, the Fund's Committee also listen to the opinion of expert managers at the responsible institutions and from others who were responsible for similar successful applications. This way, we may obtain relatively objective evaluations.

Distinctions must also be made when it comes to material and moral *recognition*. Obviously, the annual evaluators must be given the opportunity to make annual

awards, while in the case of extended projects the (naturally greater) material recognition should be spread out over the entire period, especially in view of the above mentioned suggestion, according to which such applicants would be held accountable only once, around the end of their projects. I can visualize that, after they no longer receive support from the Fund, some of the research teams would apply for certain institutional awards (such as the Janossy Prize given out by the Central Research Institute for Physics) or, if their achievements are particularly outstanding, they would be eligible to receive the Academy Prize or a similarly prestigious future award established by the Fund itself.

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